MATH 401: GREEN'S FUNCTIONS AND VARIATIONAL METHODS

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Topics

- Green's function for ODEs. (Distributional calculus with delta functions, BVPs for ODEs, solvability conditions, generalized Green's functions).
- Green's function for Elliptic, Parabolic, and Hyperbolic (Wave-like) PDEs. (Method of images, separation of variables, integral representations, and applications to Electromagnetics, heat and mass flow, and acoustics.)
- Eigenfunction expansions, distribution of eigenvalues, and approximation of eigenvalues.
- Calculus of variations and the optimization of functionals for ODEs and PDEs.

Prerequisites

- Differential Equations: Math 215/316, 255/257, and Math 400 is highly recommended
- Some exposure to Physics is an asset.

Course Material

There is no one text for this course as the topics are diverse and given in several different sources. As such, I will provide a detailed set of online notes for the course that should be sufficient to cover all aspects of the material. The notes are posted on the Canvas website that mirror what is on my math webpage at:

https://www.math.ubc.ca/∼ward/teaching/math401.html

Course Format and Logistics:

- I will provide 3 hours of online instruction per week that will be saved to the Canvas website for the course. This instruction will be part synchronously (live) and part asynchronously (pre-taped) and will be based to a large extent on the course notes. These lectures will be available for later reference. We will start the course synchronously (live) at the usual scheduled course time.
- At the end of each week, I will provide a brief page on Canvas to indicate where you should be in your reading of the course notes so that you keep on track with the material. In this page I will also give some simple problems that you should know how to tackle based on this reading.
- I will have two hours per week of online live (synchronous) office hours (one mid-day and one evening session) for you to come and ask questions regarding the notes and the homework. The few problems I pose from the weekly page, described above, will help motivate the online discussion.

If you are seeking further book sources for different parts of the course, the following references are helpful:

- *Partial Differential Equations of Applied Math*, by E. Zauderer.
- *Green's Functions and Boundary Value Problems: 3rd edition*, by I. Stakgold and M. Holst.
- *Partial Differential Equations: An Introduction*, by W. Strauss.
- *Calculus of Variations*, by I. Gelfand and S. Fomin.

Grading

- There will be seven homework assignments to be turned in. The homeworks will be on the Canvas course page and will be mirrored on my math department webpage linked above. The HW must be turned in as one .pdf file to Canvas with the filename `hwx_yourstudentnumber.pdf` (not as a bunch of separate .jpeg pages): i.e. if your student number is 2345678 and it is hw1, then the file name is `hw1_2345678.pdf` (25% of your grade)
- There will be 3 take home quizes consisting of two problems each. They will be assigned on a Friday and must be turned in late Sunday night on Canvas with the file name `quizx_yourstudentnumber.pdf` (15% of your grade)
- There will be an online synchronous 1-hour midterm in the middle of the course held during a class-time period. Most likely this will be in early March. The file name for upload to Canvas is `midterm_yourstudentnumber.pdf`. (20% of your grade)
- There will be one online synchronous 2.5 hour final exam. (40% of your grade).
- For the midterm and final exam there will be a grace period at the end of the exam for you to take a photo of your work, make a .pdf, and upload to Canvas. **Important:** You have key task in the first week of class to find a good app or other program to take a photo of your work and to upload as one .pdf file. We will practice with this simple but important technical skill.